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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: Vehicle Carrying Rail Road Car and Bridge Plate Therefor

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT We,

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James W. Forbes, of 15 Glenron Road, R.R. #2, Campbellville, Ontario, Canada L0P 1B0, citizen of Canada,

have invented a : **VEHICLE CARRYING RAIL ROAD CAR AND BRIDGE PLATE THEREFOR**

of which the following is a specification.

VEHICLE CARRYING RAIL ROAD CAR AND BRIDGE PLATE THEREFOR

Field of the Invention

This invention relates to the field of rail road cars for carrying wheeled vehicles.

Background of the Invention

Railroad flat cars are used to transport highway trailers from one place to another in what is referred to as intermodal Trailer-on-Flat-Car (TOFC) service. TOFC service competes with intermodal container service known as Container-on-Flat-Car (COFC), and with truck trailers driven on the highway. TOFC service has been in relative decline for some years due to a number of disadvantages.

First, for distances of less than about 500 miles (800 km), TOFC service is thought to be slower and less flexible than highway operation. Second, in terms of lading per rail car, TOFC tends to be less efficient than Container-on-Flat-Car (COFC) service, and tends also to be less efficient than double-stack COFC service in which containers are carried on top of each other. Third, TOFC (and COFC) terminals tend to require significant capital outlays. Fourth, TOFC loading tends to take a relatively long time to permit rail road cars to be shunted to the right tracks, for trailers to be unloaded from incoming cars, for other trailers to be loaded, and for the rail road cars to be shunted again to make up a new train consist. Fifth, shock and other dynamic loads imparted during shunting and train operation may tend to damage the lading. It would be advantageous to improve rail road car equipment to reduce or eliminate some of these disadvantages.

As highways have become more crowded, demand for a fast TOFC service has increased. Recently, there has been an effort to reduce the loading and unloading time in TOFC service, and an effort to increase the length of TOFC trains. There are two methods for loading highway trailers on flat cars. First, they can be side-loaded with an overhead crane or side-lifting fork-lift crane. Loading with overhead cranes, or with specialized fork-lift equipment tends to occur at large yards, and tends to be capital intensive.

The second method of loading highway trailers, or other wheeled vehicles,

onto rail road cars having decks for carrying vehicles, is by end-loading. End-loading, or circus loading as it is called, has two main variations. First, a string of cars can be backed up to a permanently fixed loading dock, typically a concrete structure having a deck level with the deck of the rail cars. Alternatively, a movable ramp can be placed at one end of a string of rail car units. In either case, the vehicles are driven onto the rail road cars from one end. Each vehicle can be loaded in sequence by driving (in the case of highway trailers, by driving the trailers backward) along the decks of the rail road car units. The gaps between successive rail car units are spanned by bridge plates that permit vehicles to be driven from one rail car unit to the next. Although circus loading is common for a string of cars, end-loading can be used for individual rail car units, or multiple rail car units as may be convenient.

One way to reduce shunting time, and to run a more cost effective service is to operate a dedicated unit train of TOFC cars whose cars are only rarely uncoupled. However, as the number of units in the train increases, circus loading becomes less attractive, since a greater proportion of loading time is spent running a towing rig back and forth along an empty string of cars. It is therefore advantageous to break the unit train in several places when loading and unloading. Although multiple fixed platforms have been used, each fixed platform requires a corresponding dedicated dead-end siding to which a separate portion of train can be shunted. It is not advantageous to require a large number of dedicated parallel sidings with a relatively large fixed investment in concrete platforms.

To avoid shunting to different tracks, as required if a plurality of fixed platforms is used, it is advantageous to break a unit train of TOFC rail road cars on a single siding, so that the train can be re-assembled without switching from one track to another. For example, using a 5000 or 6000 ft siding, a train having 60 rail car units in sections of 15 units made up of three coupled five-pack articulated cars, can be split at two places, namely fifteen units from each end, permitting the sequential loading of fifteen units per section to either side of each split. Once loaded, the gaps between the splits can be closed, without shunting cars from one siding to another. Use of a single siding is made possible by moving the ramps to the split location, rather than switching strings of cars to fixed platforms.

In using movable ramps for loading, the highway trailers are typically backed onto the railcars using a special rail yard truck, called a hostler truck. Railcars can be equipped with a collapsible highway trailer kingpin stand. When the highway trailer is in the right position, the hostler truck hooks onto the collapsible stand (or hitch) and

pulls it forward, thereby lifting it to a deployed (i.e., raised) and locked position. The hostler truck is then used to push the trailer back to engage the kingpin of the hitch. The landing gear of the highway trailer is lowered, and, in addition, it is cranked downward firmly against the rail road car deck as a safety measure in the event of a hitch failure or the king pin of the trailer is sheared off. Once one trailer has been loaded, the towing rig, namely the hostler truck, drives back to the end of the string, another trailer is backed into place, and the process is repeated until all of the trailers have been loaded in the successive positions on the string of railcars. Unloading involves the same process, in reverse. In some circumstances circus loaded flat cars can be loaded with trucks, tractors, farm machinery, construction equipment or automobiles, in a similar manner, except that it is not always necessary to use a towing rig.

From time to time the train consist may be broken up, with various highway-trailer-carrying rail road cars being disconnected, and others being joined. Bridge plates have been the source of some difficulties at the rail car ends where adjacent railroad cars are connected, given the nomenclature “the coupler ends”. Traditionally, a pair of cars to be joined at a coupler would each be equipped with one bridge plate permanently mounted on a hinged connection on one side of the car, typically the left hand side. In this arrangement the axis of the hinge is horizontal and transverse to the longitudinal centerline of the rail car.

Conventionally, for loading and unloading operations, the bridge plate of each car at the respective coupled end is lowered, like a draw bridge, into a generally horizontal arrangement to mate with the adjoining car, each plate providing one side of the path so that the co-operative effect of the two plates is to provide a pair of tracks along which a vehicle can roll. When loading is complete, the bridge plates are pivoted about their hinges to a generally vertical, or raised, position, and locked in place so that they cannot fall back down accidentally.

Conventionally, bridge plates at the coupler ends are returned to the raised, or vertical, position before the train can move, to avoid the tendency to become jammed or damaged during travel. That is, as the train travels through a curve, the bridge plates would tend to break off if left in the spanning position between the coupler ends of two rail road cars. Since bridge plates carry multi-ton loads, they tend to have significant structure and weight. Consequently, the requirement to raise and lower the bridge plates into position is a time consuming manual task contributing to the relatively long time required for loading and unloading. Raising and lowering bridge

plates may tend to expose rail-yard personnel to both accidents and repetitive strain injuries caused by lifting.

It would be advantageous to have (a) a bridge plate that can be moved to a storage, or stowed, position, with less lifting; (b) a bridge plate system that does not require the bridge plate to be moved by hand as often, such as by permitting the bridge plate to remain in place during train operation, rather than having to be lowered every time the train is loaded and unloaded, and raised again before the train can move.

Further, a rail road car may sometimes be an internal car, with its bridge plates extended to neighbouring cars, and at other times the rail road car may be an "end" car at which the unit train is either (a) split for loading and unloading; (b) coupled to the locomotive; or (c) coupled to another type of rail road car. In each case, the bridge plate at the split does not need to be in an extended "drive-over" position, and should be in a stowed position. Therefore it is advantageous to have a rail car with bridge plates that can remain in position during operation as an internal car in a unit train, and that can also be stowed as necessary when the car is placed in an end or split position.

However, a bridge plate that is to be left in place to span a gap between adjacent releasably coupled vehicle carrying rail road cars while the train is moving must be able to accommodate relative pitch, yaw, roll and slack action motions between the coupler ends of two adjacent cars during travel. For example, when a train travels through a curve, the gap spanned by the bridge plate on the inside of the curve will shorten, and the gap spanned by the bridge plate on the outside of the curve will lengthen. When passing over switches, the coupler ends of adjacent railroad cars may be subject to both angular and transverse displacement relative to each other. All of these displacements are complicated by the need to tolerate slack action. Slack action includes not only the actual slack in the couplers themselves, but also the run-in and run-out of the draft gear, (or sliding sills, or end of car cushioning devices) of successive rail cars in the train. This combination of displacements does not occur at the articulated connectors between units of an articulated rail road car (which are joined at a common, virtually slackless pin), but does occur at the coupler ends. If the vehicle carrying rail road cars have long travel draft gear, such as sliding sills or long travel end of car cushioning (EOCC) units, the potential range of motion that would have to be tolerated by stay-in-place bridge plates at the "drive-over" coupler ends of railroad cars would be quite large relative to the nominal gap to be spanned with the

cars at an undeflected equilibrium on straight, flat track.

One approach is to reduce the amount and type of train motion to which stay-in-place bridge plates may be subjected. It is advantageous to reduce the amount of slack in the releasable coupling, as by using a low slack, or slackless coupler, and to reduce the travel in the draft gear, as by using reduced travel draft gear. In addition, reduction in overall slack action in the train has a direct benefit in improving ride quality, and hence reducing damage to lading.

One way to reduce slack action is to use fewer couplings. To that end, since articulated connectors are slackless, and since the consist of a unit train changes only infrequently, the use of articulated rail road cars significantly reduces the slack action in the train. Some releasable couplings are still necessary, since the consist does sometimes change, and it is necessary to be able to change out a car for repair or maintenance when required.

Reduction in the travel of draft gear or end-of-car cushioning units (EOCC) runs directly counter to the development of draft gear since the 1920's or 1930's. There has been a long history of development of longer travel draft gear to provide lading protection for relatively high value lading requiring gentler handling, in particular automobiles and auto parts, but also farm machinery, or tractors, or highway trailers. There are, or were, a number of factors that led to this tendency. First, if subject to general classification in a switching yard, the vehicle carrying rail road cars could be coupled to other types of car, rather than merely other vehicle carrying cars. As such, they would be subject to slack run-in (i.e, buff) loads imposed by grain cars, gondola cars, box cars, centerbeam cars, and so on. That is, they were exposed to buff loads from cars having the full range of slack of Type-E couplers, and the full range of travel of conventional draft gear. Second, if subject to flat switching, the often less than gentle habits of rail yard personnel might lead to rather high impact loads during coupling.

In such a hostile operating environment, long travel draft gear or long travel EOCC units are the customary means for protecting the more fragile types of lading. Historically, common types of draft gear, such as that complying with, for example, AAR specification M-901-G, have been rated to withstand an impact at 5 m.p.h. (8 km/h) at a coupler force of 500,000 Lb. (roughly 2.2 x 10^6 N). Typically, these draft gear have a travel of 2 ¾ to 3 ¼ inches in buff before reaching the 500,000 Lb. load, and before "going solid". The term "going solid" refers to the point at which the draft

gear exhibits a steep increase in resistance to further displacement. While deflection of about 3 inches at 500,000 lbs. buff load may be acceptable for coal or grain, it implies undesirably high levels of deceleration or acceleration for more fragile lading, such as automobiles or auto parts. If the impact is sufficiently large to make the draft gear "go solid", then the force transmitted, and the corresponding acceleration imposed on the lading, increases sharply.

Draft gear development has tended to be directed toward providing longer travel on impact to reduce the peak acceleration. In the development of sliding sills, and latterly, hydraulic end of car cushioning units, the same impact is accommodated over 10, 15, or 18 inches of travel. Given this historical development, it is counter-intuitive to employ short-travel, or ultra short travel, draft gear for carrying wheeled vehicles. However, aside from facilitating the use of stay-in-place coupler end bridge plates, the use of short travel, or ultra-short travel, buff gear has the advantage of eliminating the need for relatively expensive, and relatively complicated EOCC units, and the fittings required to accommodate them. This may tend to permit savings both at the time of manufacture, and savings in maintenance during service.

Short travel draft gear is presently available. As noted above, most M-901-G draft gear "go solid" at an official rating travel of 2 ¾" to 3 ¼" of compression under a buff load of 500,000 lbs. Mini-BuffGear, as produced by Miner Enterprises Inc., of 1200 State Street, Geneva Illinois, appears to have a displacement of less than 0.7 inches at a buff load of over 700,000 lbs., and a dynamic load capacity of 1.25 million pounds at 1 inch travel.

In addition to M-901-G draft gear, and Mini-BuffGear, it is also possible to obtain draft gear having less than 1 ¾ inches of deflection at 450,000 Lbs., one type having about 1.6 inches of deflection at 450,000 Lbs. This is a significant difference from most M-901-G draft gear.

Furthermore, in seeking a low slack, or slackless train, it is desirable to adopt low-slack, or slackless couplings. Although reduced slack AAR Type F couplers have been known since the 1950's, and slackless "tightlock" AAR Type H couplers became an adopted standard type on passenger equipment in 1947, AAR Type E couplers are still predominant. AAR Type H couplers are expensive, and are used for passenger cars, as are the alternate standard Type CS controlled slack couplers. According to the 1997 Cyclopedia, supra, at p. 647 "Although it was anticipated at one time that the F type coupler might replace the E as the standard freight car

coupler, the additional cost of the coupler and its components, and of the car structure required to accommodate it, have led to its being used primarily for special applications". One "special application" for F type couplers is in tank cars.

The difference between the nominal 3/8" slack of a Type F coupler and the nominal 25/32" slack of a Type E coupler may seem small in the context of EOCC equipped cars having 10, 15 or 18 inches of travel. By contrast, that difference, 13/32", seems proportionately larger when viewed in the context of the approximately 11/16" buff compression (at 700,000 lbs.) of Mini-BuffGear. It should be noted that there are many different styles of Type E and Type F couplers, whether short or long shank, whether having upper or lower shelves. There is a Type E/F having a Type E coupler head and a Type F shank. There is a Type E50ARE knuckle which reduces slack from 25/32" to 20/32". Type F herein is intended to include all variants of the Type F series, and Type E herein is intended to include all variants of the Type E series having 20/32" of slack or more.

Stay-in-place bridge plates are intended to accommodate the range of travel defined by the combination of coupler and draft gear, given anticipated service loads. While it may be possible to operate telescoping bridge plates, they are relatively less advantageous than monolithic bridge plates. First, a telescoping device may require a more challenging installation procedure if two sliding parts have to be inserted in each other. Second, the telescoping device must be able to telescope, and yet must also be able to support the vertical load carried on the slide. A slide with significant tolerance may not necessarily support bending moments well, may tend to wear under repeated loading, and may cease to slide very well if damaged or bent due to the vertical loads. A monolithic beam has no moving parts requiring careful manufacturing tolerance, and has no moving parts that may deform and jam in service. Slides may accumulate sand and dirt, and may cease to function if water is able to freeze in the slide.

Loading and unloading of highway trailers, or other vehicles in the manner described, above, can also be a relatively tedious and time consuming chore, particularly as the number of railroad cars in the string increases. Persons engaged in such activity may, after some time, perhaps late at night, tend to become less fastidious in their conduct. They may tend to become overconfident in their abilities, and may tend to try to back the highway trailers on to the rail cars rather more quickly than may be prudent. It has been suggested that speeds in the order of 20 km/h have been attempted. In the past, it has been difficult to form bridge plates that lie roughly flush with the deck. Due to their strength requirement, they tend to be about 2 inches

thick or more. As a result there is often a significant bump at the bridge plate. Aggressive loading and unloading of the trailers may cause an undesirable impact at the bump, and loss of control of the load. In that regard, it would be advantageous to reduce the height or severity of the bump. It is also advantageous to employ side sills that have a portion, such as the side sill top chord, that extends above the height of the deck and acts as a curb bounding the trackway, or roadway, defined between the side sills. It is also helpful to have flared sill, or curb, ends that may tend to aid in urging highway trailers toward the center of the trackway along the rail cars.

Demand for transport by TOFC or by container may fluctuate over time. Therefore it would be advantageous to be able to convert a rail road car from one type of service to the other. To that end it would be advantageous to have a rail road car that has structure for either service, and that permits subsequent conversion as may be desired according to market conditions.

Reference is made herein to shipping containers and various sizes of highway trailers. Shipping containers come in International Standards Association (ISO) sizes, or domestic sizes. The ISO containers are 8'-0" wide, 8'-6" high, and come in a 20'-0" length weighing up to 52,900 Lbs., or a 40'– 0" length weighing up to 67,200 Lbs., fully loaded. Domestic containers are 8'- 6" wide and 9'- 6" high. Their standard lengths are 45', 48', and 53'. All domestic containers have a maximum fully loaded weight of 67,200 Lbs. Some common sizes of highway trailers are, first the 28' pup trailer weighing up to 40,000 Lbs., and the 45' to 53' trailer weighing up to 65,000 Lbs. for a two axle trailer and up to 90,000 Lbs. for a three axle trailer.

Summary of the Invention

In an aspect of the invention there is a rail road car bridge plate. It has a beam for spanning a gap between a pair of adjacent rail road cars. The beam has an upwardly facing surface upon which vehicles can be conducted. The beam has a pivot fitting mounted thereto, to permit motion of the beam about an upwardly extending axis.

In another aspect of the invention there is a bridge plate for a vehicle carrying rail road car. The bridge plate has a beam member for spanning a space between two adjacent coupled railroad cars. The beam member has a track surface upon which wheeled vehicles can be conducted. The beam member has a pivot fitting mounted

thereto. The pivot fitting permits movement of the beam about a pivot axis normal to the track surface.

In another aspect of the invention there is a rail road car bridge plate operable to permit vehicles to be conducted thereover between respective vehicle decks of a pair of first and second longitudinally coupled rail road cars. The bridge plate has a beam locatable in a longitudinal orientation relative to the rail road cars to span a gap therebetween. The beam has a surface upon which vehicles can be conducted. The beam has a fitting by which to mount the beam to the first of the rail road cars. The fitting permits movement of the beam from the longitudinal orientation to a cross-wise orientation relative to the first rail road car.

In an additional feature of that aspect of the invention, the fitting is chosen from the set of fittings consisting of (a) a collar for receiving a pivot pin or (b) a pivot pin engageable in a collar, by which the fitting permits motion of the bridge plate between an extended position spanning a gap between the rail road cars and a storage position. In another additional feature, the fitting is a pivot fitting and, when the beam is lying horizontally, the pivot has a vertical position. In still another additional feature, the beam has a flange defining the surface. The fitting is a pivot fitting having a pivot axis perpendicular to the upper flange. In yet another additional feature, the fitting is a pivot fitting having a pivot axis perpendicular to the surface.

In a further additional feature, the surface has traction bars mounted thereto. In still a further additional feature, the second fitting is operable to engage a mating fitting of the second rail road car. In another additional feature, a second fitting is operable to engage the second rail road car. The first fitting is a pivot fitting and the second fitting is a slide fitting. In an additional feature, the second end of the bridge plate has the form of a bifurcated toe. In another additional feature, the beam has at least one hand grab mounted thereto to facilitate manipulation of the bridge plate.

In another aspect of the invention, there is a bridge plate for spanning a length-wise gap between corresponding vehicle decks of a pair of first and second releasably coupled rail road cars. The bridge plate has a beam member for supporting the weight of wheeled vehicles. The beam member has an upwardly facing surface upon which vehicles can be conducted between the rail road cars, a first fitting for engaging the first rail road car and a second fitting for engaging the second rail road car. The first fitting is mounted to connect a first end of the beam to the first rail road car. The first fitting permits pivotal motion of the bridge plate about a first axis normal to the

surface relative to the first rail road car. The second fitting mounts to connect a second end of the beam to the second rail road car. The second fitting permits pivotal motion of the bridge plate about a second axis normal to the surface relative to the second rail road car. The second fitting is operable to accommodate variation of distance between the first and second axes while the rail road cars are coupled together and in motion.

In an additional feature, when the rail road cars are uncoupled, the second end of the bridge plate is disengageable from the second rail road car, and is movable about the first axis to a cross-wise storage position. In another additional feature, the second fitting includes a slide capable of linear motion relative to the second axis.

In still another additional feature, the second end of the beam is bifurcated to form a pair of toes and the second fitting is a slot defined between the toes. In still yet another additional feature, the beam includes a top flange, a bottom flange, and webs extending therebetween. In a further additional feature, the second end of the beam has a handgrab to facilitate manipulation of the beam. In yet a further additional feature, the beam has a bottom flange, and a plastic pad mounted to the bottom flange.

In another aspect of the invention, there is a bridge plate for spanning a gap between corresponding vehicle decks of a pair of first and second releasably coupled rail road cars. The bridge plate has a first pivot fitting mountable to the first rail road car. The pivot fitting permits pivotal motion of the bridge plate relative to the first rail road car about a first vertical axis. It has a second fitting for engaging the second rail road car. The second fitting includes a linear extension member permitting pivotal motion of the bridge plate relative to a second vertical axis fixed relative to the second rail road car. The linear extension member tolerates variation in distance between the first and second axes.

In an additional feature of that aspect of the invention, the bridge plate is a beam having an upper flange, a lower flange, and vertical webs extending therebetween. In another additional feature, a slider pad is mounted to the bottom flange. In still another additional feature, the linear extension member is a slot defined in the beam.

In another aspect of the invention, there is a bridge plate kit for spanning a gap between a pair of first and second releasably coupled rail road cars. The kit has a bridge plate. A first pivot pin has a first pivot axis. The first pivot pin is mountable

to the first rail road car with the first pivot axis in a vertical orientation. A second pivot pin has a second pivot axis. The second pivot pin is mountable to the second rail road car with the second pivot axis in a vertical orientation. A bridge plate has a first fitting in engagement with the first pivot pin. The bridge plate is pivotable relative to the first pivot axis. A second fitting is in engagement with the second pivot pin. The bridge plate is pivotable relative to the second axis, and the bridge plate is translatable relative to the second axis.

In an additional feature, the first fitting is a collar matable with the first pivot pin. The second fitting is a guide matable with the second pivot pin. In another additional feature, the bridge plate includes a beam member for supporting loads to be conducted between the first and second rail road cars. The first fitting is a collar mounted to the first pivot pin. The second fitting is an elongated slot. The second pivot pin is seated in the slot. In still another additional feature, the bridge plate includes a beam member for supporting loads to be conducted between the first and second rail road cars. The beam has a pair of toes at one end thereof. The second fitting is an open ended slot defined between the toes. In still yet another additional feature, the second pivot pin is removable from the second mounting. The bridge plate has hand grabs to facilitate pivoting of the bridge plate by hand about the first pivot pin.

In yet another additional feature, the kit includes two of the bridge plates. Two of the first fittings and two of the second fittings, when installed, co-operate as a pair of side-by-side wheel trackways to define a pathway between the first and second rail road cars.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure **1a** shows a conceptual side view of a train having several articulated vehicle carrying rail road cars, in an unloaded condition;

Figure **1b** shows a portion of the train of Figure **1a** as split for loading;

Figure **1c** shows the train portion of Figure **1a** in a split configuration ready for loading;

Figure **1d** shows the train portion of Figure **1a** in a partially loaded condition;

Figure **1e** shows the train portion of Figure **1a** in a fully loaded condition;

Figure **1f** shows portions of the train of Figure **1a** in an assembled condition;

Figure **2a** shows a side view of a five-pack articulated railroad car for carrying highway trailers as loaded;

Figure **2b** shows a top view of the five pack articulated rail road car of Figure **2a** in an unloaded condition;

Figure **2c** shows a side view of the rail road car of Figure **2a** in an unloaded condition;

Figure **3a** shows an isometric view of a "B-End" unit of an articulated rail road car such as shown in either Figure **1a** or Figure **2a**, with middle floor deck plates removed for clarity;

Figure **3b** shows a top view of the articulated rail road unit car of Figure **3a**;

Figure **3c** shows a side view of the articulated rail car unit of Figure **3a**;

Figure **3d** shows an underside view of the rail road car unit of Figure **3a**;

Figure **3e** shows an end view of the articulated rail road car unit of Figure **3a**;

Figure **3f** shows a mid-span cross-section of the rail road car unit of Figure **3a**;

Figure **3g** shows an enlarged side detail of the rail car unit of Figure **3a** at the coupler end of the car;

Figure **3h** shows an enlarged top detail of the rail car unit of Figure **3a**;

Figure **4a** shows a top view of a bridge plate for the rail car unit of Figure **3a**;

Figure **4b** shows a side view of the bridge plate of Figure **4a**;

Figure **4c** shows an end view of the bridge plate of Figure **4a**;

Figure **4d** shows a section of the bridge plate of Figure **4a** taken on '**4d – 4d**';

Figure **4e** shows a section of the bridge plate of Figure **4a** taken on '**4e – 4e**';

Figure **5a** is a partial isometric view of the bridge plate of Figure **4a** in an extended position relative to the rail car unit of Figure **3a**;

Figure **5b** is a partial isometric view of the bridge plate of Figure **4a** in a stored position relative to the rail car unit of Figure **3a**;

Figure **5c** is a top view of the bridge plate of Figure **5a** showing in service deflection;

Figure **6a** is an isometric view of a transition bridge plate for the rail car unit of Figure **3a**;

Figure **6b** is a top view of the transition bridge plate of Figure **6a**;

Figure **6c** is a side view of the transition bridge plate of Figure **6a**;

Figure **7a** is an isometric view of a cam crank of the rail car unit of Figure **3a**;

Figure **7b** is a side view of the cam crank of Figure **7a**;

Figure **7c** is an end view of the cam crank of Figure **7a**;

Figure **7d** is a cross-section of the cam crank of Figure **7a** taken on '**7d – 7d**';

Figure **7e** is a view of the cam crank of Figure **7a** taken on arrow '**7e**';

Figure **7f** shows a partial cross-section of the rail car unit of Figure **3a** taken on '**7f – 7f**' showing the cam crank of Figure **7a** installed;

Figure **7g** shows a partial sectional view across the rail car unit of Figure **3a** with the cam crank of Figure **7a** installed;

Figure **8a** shows a partial side sectional view of two rail road cars having bridge plates, as shown in Figure **7a,** in a separated position;

Figure **8b** shows the rail road cars of Figure **8a** in an approach position;

Figure **8c** shows the rail cars of Figure **8a** as one bridge plate meets a cam crank;

Figure **8d** shows the rail cars of Figure **8a** in a coupled relationship;

Figure **8e** shows the rail road cars of Figure **8a** in an alternate approach position to that of Figure **8b**;

Figure **8f** shows the rail cars of Figure **8e** as one bridge plate meets a cam crank;

Figure **9a** shows an isometric view of a 'A-End" unit of the articulated rail road car of Figure **1a** with middle floor deck plates removed for clarity;

Figure **9b** shows a top view of the articulated rail road unit car of Figure **9a**;

Figure **9c** shows a side view of the articulated rail car unit of Figure **9a**;

Figure **9d** shows an underside view of the rail road car unit of Figure **9a**;

Figure **10a** shows an isometric view of an intermediate "C" unit of the articulated rail road car of Figure **1a** with middle floor deck plates removed for clarity;

Figure **10b** shows a top view of the articulated rail road unit car of Figure **10a;**

Figure **10c** shows a side view of the articulated rail car unit of Figure **10a**;

Figure **10d** shows an underside view of the rail road car unit of Figure **10a**;

Figure **11a** shows a top view of the draft gear at the coupler end of the articulated rail road car of Figure **3a**; and

Figure **11b** shows a sectional of the draft gear of Figure **11a** taken on '**11b - 11b**'.

DETAILED DESCRIPTION OF THE INVENTION

The description that follows, and the embodiments described therein, are provided by way of illustration of an example, or examples of particular embodiments of the principles of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not

necessarily to scale and in some instances proportions may have been exaggerated in order more clearly to depict certain features of the invention.

In terms of general orientation and directional nomenclature, for each of the rail road cars described herein, the longitudinal direction is defined as being coincident with the rolling direction of the car, or car unit, when located on tangent (that is, straight) track. In the case of a car having a center sill, whether a through center sill or stub sill, the longitudinal direction is parallel to the center sill, and parallel to the side sills, if any. Unless otherwise noted, vertical, or upward and downward, are terms that use top of rail, **TOR**, as a datum. The term lateral, or laterally outboard, refers to a distance or orientation relative to the longitudinal centerline of the railroad car, or car unit, indicated as **CL - Rail Car**. The term "longitudinally inboard", or "longitudinally outboard" is a distance taken relative to a mid-span lateral section of the car, or car unit. Pitching motion is angular motion of a rail car unit about a horizontal axis perpendicular to the longitudinal direction. Yawing is angular motion about a vertical axis. Roll is angular motion about the longitudinal axis.

By way of general overview, Figures **1a** to **1f** illustrate the process of loading wheeled vehicles onto a train of multi-unit articulated railroad cars. In this example, an assembled train of articulated rail road cars, indicted generally as **20**, includes a string of three-pack articulated railroad cars **21**, **22** , **23** and **24** joined together with a two rail car unit articulated rail road car **25**, drawn by a locomotive indicated as **38**. Train **20** travels in a longitudinal direction toward its destination. While train **20** is travelling, bridge plates **150** (described more fully below) remain extended in a length-wise (i.e., longitudinal) "drive-over" orientation, such as shown in Figure **5a** below, to span the gap at the releasable coupling between the decks of the adjacent rail car units of rail road car **21** and rail road car **22**, as well as between rail road cars **23** and **24**, **24** and **25**. At the coupled connection between rail road cars **22** and **23**, bridge plates **150** do not extend lengthwise but are disposed in a stowed, cross-wise orientation, transverse to the longitudinal centerlines of the rail road cars, as shown in Figure **5b** below. Likewise, at the ends of the string of vehicle carrying rail road cars, such as adjacent locomotive **38**, at the end of train location, (or, in another context, at a car coupled to a different type of freight car), bridge plates **150** are also placed in their stowed position, as in Figure **5b**. It is preferred that train **20** be a unit train composed of vehicle carrying rail road cars, and not coupled to any other type of car.

In the second, enlarged, partial view of Figure **1b**, train **20** has arrived at its destination, and a rear portion **27** of train **20** has been spotted at a first location, while another, more forward portion **29** has been spotted further along the track. The two portions are separated by a few hundred feet. Train **20** has been split at the releasable coupling between the rear end unit of rail road car **22** and the forward end unit of rail road car **23**. In the separated position of Figures **1b**, **1c**, **1d**, and **1e**, the cross-wise stowed orientation of the bridge plates at the opposing ends of rail road cars **22** and **23** facilitates use of movable ramps **59** for loading, or unloading, of train **20**. As shown in the succession of views of Figures **1c**, **1d**, **1e** and **1f**, hostler trucks **40** are used to move ramps **59** into place adjacent the split, (i.e., uncoupled), ends of rail road cars **22** and **23**, and are then used to back wheeled vehicles, in this instance highway trailers **42**, into place, each highway trailer **42** facing the split, with its king pin engaging the hitch plate of a collapsible hitch **112** or **114** (see below), and its landing gear cranked firmly down. (Other types of wheeled vehicles, whether automobiles, trucks, farm machinery, or buses could be loaded in a similar manner, with or without a towing tractor, as may be suitable). At the internal ends of rail road cars **21**, **22**, **23**, **24**, and **25**, the length-wise extended bridge plates make those ends "drive-over" ends that permit highway trailers to be conducted along a continuous path between cars.

When all of the rail car units have been loaded, train **20** is ready. The split, (or splits, as the case may be) can be closed by gently shunting the forward and rearward portions **29** and **27** together. Train **20** is then ready to depart for its next destination. In the example train **20** arrives empty. However, it would be customary for the loading procedure described to have been preceded by an unloading procedure for highway trailer units arriving from the previous depot, as by reversing the steps of Figures **1e**, **1d**, **1c** and **1b**.

Describing elements of train **20** in greater detail, coupled units **22** and **23** have respective first, or "drive over" end units **26**, and **28**, intermediate articulated units **30** and **32**, and coupled end units **34** and **36**. For the purposes of this description, it can be taken that units **26** and **28** are the same, units **30** and **32** are the same, and units **34** and **36** are the same, but facing in opposite directions. Each of the rail car units having a coupler end, namely units **26** and **28**, **34** and **36**, has an end truck, **35**, mounted under a main bolster at the coupler end, whichever end it may be. Rail car units **26** and **30**, **30** and **34**, **36** and **32**, and **32** and **28** are joined together by articulated connectors indicated generally as **37**, mounted over respective shared articulated connection trucks **39**. Rail car units **34** and **36** are connected by releasable couplers **44** and **46**. Articulated connector bridge plates **300** (whether left or right

handed, as described below) span the gaps between rail car units **26** and **30**, **30** and **34**, **36** and **32**, and **32** and **28**. With the aid of articulated connector bridge plates **300**, and movable bridge plates **150**, to one side of the split between rail road cars **22** and **23**, decks **47**, **48**, **49**, **50**, **51**, and **52**, (and to the other side, **47**, **48**, **49**, **50**, **51**, **52**, **53** and **54**) form continuous pathways, or roadways, upon which vehicles can be conducted in either forward, driving, direction or a reverse, backward direction. If additional railroad cars are joined at the opposite ends of railroad cars **22** and **23**, further bridge plates can be employed to extend the length of the pathway.

For the purposes of this description, although Figures **1a**, **1b**, **1c**, **1d**, **1e**, and **1f** show a locomotive and three-pack or two-pack articulated cars, other combinations of articulated cars having any reasonable number of articulation units can be employed. 2-unit, 3-unit, and 5-unit articulated packs are relatively common. It will be understood that the example of Figures **1a** – **1f** is meant symbolically to represent a train of any suitable length. Typically, a unit train would include a much larger number of cars units, such as 60 or 80 rail car units composed of a multiplicity of 2, 3, 5 or 6 (or more) unit articulated cars strung together. Such a train can be directed onto a siding, with successive portions of the string spotted at different locations along the siding, leaving gaps of, typically, 200 or 300 feet between sections to permit the placement of ramps as may be suitable. When the cars are loaded, the ramps are removed. The locomotive can then reverse, closing each successive gap and permitting the rail road cars to be reconnected at their respective coupler ends.

In the example shown, end rail car units **26** of rail road car **21**, and **28** of rail road car **25**, each have a movable bridge plate **150** carried at their uncoupled ends (in the case of rail car unit **26**, the "uncoupled end" is actually coupled to locomotive **38**, the context of "uncoupled" meaning an end that is not coupled to another similar rail car for carrying vehicles to which a bridge plate would be extended). If a larger train were assembled, the uncoupled ends of car units **26** and **28** would be coupled to mating ends of other articulated cars. When additional cars are joined, the collapsible hitches are oriented in the same direction, namely, all facing toward the location of the split. Thus, away from the split, a car unit **26** would mate with a car unit like car unit **34**, and so on. In a long train there would tend to be more than one split.

For the purposes of illustration, rail road car **22**, which includes rail car units **26**, **30**, and **34** will be described in greater detail. It will be appreciated that a two-unit articulated rail road car, such as rail road car **25**, can be assembled by joining units **26** and **34** directly together, and that, in general, articulated rail cars of varying lengths

can be assembled from a pair of ends units, such as units **26** and **34**, and any chosen number of intermediate units (i.e., cars not having coupler ends) such as unit **30**. A five-pack assembled in this way is shown loaded in Figure **2a**, and unloaded in Figures **2b** and **2c**. For the purposes of this description, unit **26** is arbitrarily designated as the "A-End" unit, unit **34** is the "B-End" unit, and unit **30** is the "C", or intermediate unit. In rail road terminology the "B" end of a rail road car is the handbrake end, or predominant hand brake end. When several "C" units are employed in a multi-unit articulated rail road car, as in the five pack of Figures **2a**, **2b** and **2c**, each may be referred to as the "C', "D", or "E" unit (and so on if more units are used). There are minor structural differences between the intermediate units, such as whether one hitch is provided or two, and corresponding cross-bearer and deck web reinforcements. For the purposes of this structural description any intermediate car unit will be referred to as a "C" unit, and unit **30** will be taken as representative of intermediate units in general, whatever their hitch layout may be.

The second end unit (the "B" unit) **34** is shown in Figures **3a**, (isometric, with decking partially removed to reveal deck supporting structure), **3b** (side) **3c** (top view, with decking partially removed to reveal structure) **3d** (underframe) and **3e** (coupler end view). Car unit **34** has a main longitudinal structural member in the nature of a main center sill **60** having a draft pocket **62** at one end (i.e., the "coupler end" portion, **64** of unit **34**), and an articulated connector socket in the nature of a rectangular fabricated steel box **66** into which one half of an articulated connector **68** is mounted at the other end (i.e., the articulated connection end portion, **70** of car unit **34**). In between the coupler end portion **66** and the articulated end portion **70** is a central portion, **72**, being the mid-span portion of the car between its trucks.

As shown in the offset section of Figure **3f**, over the central portion **72**, of unit **34** center sill **60** has the form of a hollow beam having a top flange **74**, a bottom flange **76**, and a pair of spaced apart vertical webs **78**, **80**. A set of cross-bearers **82** extend outwardly from roots at the side webs of center sill **60** to laterally outboard ends that meet in lap welded joints with vertical gussets **83** of meet side sills **84** and **86**. Each of side sills **84** and **86** has a hollow rectangular top chord member **90**, an outer cowling sheet, or web **92**, a bottom chord in the form of an angle **94**, and a cross-bearer flange extension **96** in the form of a bent member welded to the inner face of top chord member **90** in a downwardly hanging position, the upward portion, or leg of extension **96** lying on the same slope as the top chord web, the inwardly extending portion, or leg, of extension **96** lying roughly horizontally to provide a lip that is welded to the top flange of the cross-bearer.

Floor panels **100** span the pitches between cross-bearers **84**, to provide a continuous pathway from one end of the car to the other. Each floor panel **100** is formed from a series of spaced apart, longitudinally extending channels **102, 103, 104** surmounted by a top sheet, or flange **106** whose upper surface **108** forms a path for the wheels of vehicles loaded on the car unit. Upper surface **108** is roughly flush with top flange **74** of center sill **60**, and floor panels **100** and top flange **74** co-operate to form deck **47** of rail car unit **34**. Side sills **84** and **86**, run along the sides of deck **47**. Top chord member **90** of each of side sills **84** and **86** extends well above the level of top surface **108**, and serves as a curb to encourage trailers to stay on the trackway, or roadway, defined on deck **47** between top chord members **90**, as they are backed along the rail car unit.

Each of side sills **84** and **86** is canted inwardly, such that its lower extremity, or toe, is nearer to the rail car longitudinal centerline than the top chord. The inward cant of top chord member **90** of side sills **84** and **86** gives this curb an angle or chamfer, as shown in Figure **3f**, such that a truck tire must ride up the slope before it can escape, the chamfer yielding a self-centering effect as the tires try to ride along it. Although only a few floor panels **100** are shown, it will be appreciated that floor panels **100** are located continuously to permit vehicles to be driven over the car units, as in Figure **2b**.

At either end of the central portion of car unit **34**, there are dual purpose cross-beams **109, 110** located at longitudinal stations corresponding to the 40 ft container pedestal locations of a container carrying rail car.

A first collapsible hitch **112** is also mounted to top flange **74** of center sill **60** in a mid span position for engaging a 28' pup-trailer, if required. A second collapsible hitch **114** is mounted roughly 4 inches inboard from the truck center, **CL Truck**, at coupler end, end portion **64**. The cross-bearer flanges are reinforced under the hitch locations, as shown at **116**.

At the coupler end, end portion **64**, main center sill **60** of rail car unit **34** becomes shallower, the bottom flange being stepped upwardly to a height suitable for being supported on truck **35**. Side sills **84** and **86** also become shallower as the bottom flange curves upward to clear truck **35**. Rail car unit **34** has a laterally extending main bolster **120** at the longitudinal station of the truck center (**CL Truck**), and a parallel, laterally extending end sill **122** having left and right hand arms **121**,

123 extending laterally between the coupler pocket and the side sills. In their distal, or outboard regions, arms **121** and **123** have ramp engagement sockets **125** in the nature of rectangular apertures, with which prongs **127** of ramp **59** can be engaged to align ramp **59** with car unit **34** for loading.

As shown in Figure **7g**, top flange **74** of center sill **60** has a downwardly sloping transition **124** longitudinally outboard of main bolster **120**, and a level, horizontally extending portion **126** lying outboard thereof, such that the end portion of center sill **60** is stepped downward relative to the main portion of top flange **74** inboard of bolster **120**. A bridge plate support member, in the nature of an outboard horizontal shelf portion **134**, includes left and right hand plates **128**, **130** that form upper flanges for, and extend longitudinally inboard of, arms **121** and **123** of end sill **122** to define bridge plate support members.

A laterally extending structural member, in the nature of a fabricated closed beam **136** is welded to horizontal portion **126** of center sill **60** between side sills **84** and **86**. Beam **136** has vertical legs **138** extending upwardly of portion **126** and a horizontal back **140**, lying flush with the level of top flange **74** at the longitudinal location of main bolster **120**. Left and right hand deck plates **141** are welded to back **140** and extend above tapered portion **130** to terminate at main bolster **120**.

Plates **128** and **130** are flush with downwardly stepped horizontal portion **126** of top flange **74**, and co-operate with portion **126** to define a continuous shelf across (i.e., extending cross-wise relative to) the end of rail car unit **34**, outboard of the end of deck **47** defined by the longitudinally outboard edge of beam **136**. In this way a step, depression, shelf, or rebate, or recess **142** for accommodating (or for receiving) a bridge plate, is formed in the end of rail car unit **34** adjacent to the coupler **144**, upon which bridge plate **150** can rest, as described below.

When seen from above, as in Figure **3h**, the outboard end portions **146** and **148** of side sills **84** and **86**, respectively, are splayed laterally outward to give a flared end to the pathway, trackway, or roadway, defined between the curbs of their respective top chord members **90**. The flare is achieved with a mitre, or chamfer, but could also be achieved with a smooth curve, and serves to provide a lead-in for truck wheels to the straight curb portions of top chord members **90** and to allow motion of the bridge plates during operation, as indicated in Figure **5c**.

A gap spanning structural member, or beam, namely bridge plate **150**, is

indicated in Figures **4a**, **4b**, **4c**, and **4d**. Bridge plate **150** is preferably of steel construction, but could be of aluminum, or suitable reinforced engineered plastics, to reduce the weight to be manipulated by railyard crews. Bridge plate **150** has the construction of a rigid flanged beam, having a top flange, or sheet **152**, upon whose upper surface **154** vehicles can be conducted. Sheet **152** is backed by a pair of spaced apart, longitudinally extending channel members **155** and **156**, welded with toes against sheet **152**. A pair of formed angles **158** and **160** are welded laterally outboard of channel members **155** and **156**, and a plate **162** is welded to span the gap between the backs of channel members **155** and **156**. In this way plate **162**, the backs of channel members **155** and **156**, and the horizontal legs **164** and **166** of formed angles **158** and **160** act as a bottom flange in opposition to the top flange, sheet **152**, with the other legs and toes acting as vertical shear transfer webs. A traction enhancement means is provided to give bridge plate **150** a non-smooth, or roughened track, in the nature of laterally extending, parallel, spaced tread bars **168** welded to the mid-span portion of sheet **152**.

At one end, defined as the proximal, or inboard end, **170** bridge plate **150** has a pivot fitting, in the nature of a pair of aligned holes **172**, **173** formed in sheet **152** and plate **162** to define a hinge pin passage. The axis **174** of the passage formed through hole **172** is normal (i.e., perpendicular) to upper surface **174** of sheet **152**, and, in use, is ideally vertical, or predominantly vertical given tolerance and allowance for yaw, pitch, and roll between the rail road cars. Proximal end **170** is chamfered as shown at **176**, **178** and is boxed in with web members **180**, **182**. Although a mitre is preferred for simplicity of manufacture, either end of bridge plate **150** could have a rounded shape, rather than a mitre.

At the other end, defined to be the distal, or outboard end, **184**, bridge plate **150** is bifurcated, having a linear expansion member in the nature of a longitudinally extending guideway, or slot, **186**, defined between a pair of tines, or toes **188**, **190**, each having an external chamfer as shown at **192**, **194**. The distal ends of channel members **154**, **156** are also boxed in at distal end **184** as shown at **196**. A web member, in the nature of a gusset **198** is welded between the facing walls of channels **155** and **156**, adjacent to the groin of slot **186**, to encourage toes **188** and **190** to maintain their planar orientation relative to each other.

As shown in Figures **5a**, bridge plate **150** can be mounted in an employed, drive-over, or length-wise extended position, in which distal end **184** is located longitudinally outboard of end sill **122**, and in which the longitudinal axis of bridge

plate **150** is parallel to the longitudinal centerline axis of car unit **34** (on straight track, but otherwise depending on pitch and yaw between cars) to permit vehicles to be conducted between cars. Bridge plate **150** can also be mounted in a stowed, lateral, transverse or cross-wise position, as shown in Figure **5b**, in which the centerline of bridge plate **150** is perpendicular to the longitudinal centerline of car unit **34**.

Shelf portion **134** has a first bore formed therein to one side of longitudinal centerline of unit **34**. A pivot fitting, or mounting fitting, in the nature of a collar **200** is mounted flush with, or slightly shy of the upper surface of shelf portion **134**, at a first location, indicated as bore **202**, for alignment with through hole **172**. As discussed below in the context of Figures **8a** - **8c** the toe of bridge plate **150** can be tipped up slightly. To do this, the rear, or longitudinally inboard edge of shelf portion **134** acts as a fulcrum. A retaining member, in the nature of a hinge pin **204**, is fabricated from a section of pipe **206** of a size permitting a loose fit within collar **200** to allow for roll, pitch and yaw between cars. Pipe **206** has a flange **208** mounted at one end, the proximal or upper end. Flange **208** bears on sheet **152** to prevent pipe **206** from falling though collar **200**. Pin **204** also has a lifting fitting in the nature of a internal cross bar **209** mounted at the flanged end. Bar **209** is grasped to withdraw pin **204** (or **205**, below). The distal or lower end of pipe **206** is slotted to accept a transverse pin **210**, itself held in place by a locking member in the nature of a cotter pin, that prevents hinge pin **204** from unintentionally lifting out or collar **200**. Shelf portion **134** also has an abutment, or stop, not shown, welded to the upper surface of plate **130** to prevent bridge plate **150** from being pivoted past the stowed position, and so preventing the side of bridge plate **150** from hitting cam crank **241** (described below) inadvertently if transition plates **232** is in the raised position (also described below).

When hinge pin **204** is in place, bridge plate **150** is restricted, or constrained, within the limits of a loose fit, to a single degree of freedom relative to rail car unit **34**, namely pivotal motion about a vertical axis. The sloppy, or loose, fit of hinge pin **204** within collar **200** gives a limited amount of play to permit tipping the bridge plate upward during coupling, and to permit sufficient roll, pitch and yaw for normal railroad operation. In the preferred embodiment, a nylon (t.m) pad **211** is mounted to the underside of bridge plate **150** to provide a bearing surface for riding against shelf portion **134**. In alternative embodiments other types of relatively slippery, high density, or UHMW, polymer materials could be used.

Shelf portion **134** of shear plate **130** has a second bore formed therein offset to

the other side of longitudinal underside of car unit **34**. As shown in Figure **7g**, another collar **200** is mounted to the underside of, and flush with (or, shy of) plate **128** of shelf portion **134** at a second location, indicated as bore **214**, at the same longitudinal station as bore **202** for alignment with slot **186** when bridge plate **150** is in the lateral, or storage, position resting fully on shelf portion **134**. Another hinge pin **205**, of the same construction as pin **204** described above, is provided to secure bridge plate **150** in the stowed position, the distal end of pin **205** locating in bore **202** and the proximal end locating in slot **186** defined between toes **188, 190**. When hinge pin **205** is removed, bridge plate **150** is able to pivot about the hinge formed by the co-operation of hinge pin **204**, collar **200** and through hole **172**.

When a bridge plate such as bridge plate **150** is in the extended (i.e., lengthwise, or longitudinal) position, and its distal end (or tip) engages the adjacent car, pin **205** is again used, this time to provide a positive, securing, retaining, indexing, or alignment member to the engaging fitting, namely slot **186**. Slot **186** is then constrained, within the confines of a loose fit, to permit motion along a first linear degree of freedom, namely to slide as the gap between cars shortens and lengthens as adjacent rail car units yaw, or translate transversely, relative to each other, and a rotational degree of freedom relative to the locating pin, i.e., pin **205**, of the adjacent car. As above, the loose fit of pin **205** in slot **186** allows for normal pitch and roll motion of the cars. As shown in Figure **5c**, the combination of a rotational degree of freedom at pin **204** of one rail road car, and both rotational and linear displacement at pin **205** of the other rail road car, accommodates both curving and transverse displacement of the coupler ends relative to each other. That is, the interaction of slot **186** with pin **205** provides both a pivot fitting for accommodating yawing motion of the adjacent rail road car, but also provides a linear expansion member for accommodating variation in distance between the respective vertical axes of pin **204** (and, collar **200**) of one rail road car, e.g., car **22**, and pin **205** (and its collar **200**) of the adjacently coupled rail road car, e.g., car **21**.

When viewed in Figure **4a** it can be seen that bridge plate **150** has cut-outs **216, 218** formed in its distal end to accommodate cam crank **241** (described below) when bridge plate **150** is in the stowed position, and a pair of hand hold rungs **220, 222** mounted to the chamfer of toes **188, 190** to facilitate pulling of bridge plate **150** from the stowed position, and to facilitate tipping the distal end, or toe, of bridge plate **150** upward, preparatory to coupling two rail car unit coupler ends together.

Left and right hand transition plates are shown in Figure **6a**, **6b**, and **6c** as **230**,

232. Each has pivot fittings in the nature of arcuate hinge tangs **234**, **236** extending from proximal edge **235**. Hinge tangs **234**, **236** locate in corresponding apertures, namely rectangular slots **238**, **240** (Figure **7g**) formed in back **140** of formed channel **136**. Hinge tangs **234**, **236** and slots **238**, **240** co-operate to permit upward lifting of their distal tips by pivotal motion of each of transition plates **230**, **232** about a horizontal pivot axis lying perpendicular to the longitudinal centerline of rail car unit **34**. As above, there is tolerance in the fit of tangs **234**, **236** and slots **238**, **240** to allow for normal railcar motion. Transition plates **230** and **232** cover the gap that could otherwise exist between the inboard, or proximal end of bridge plate **150** (on one side, i.e., **230**) or the toes of the bridge plate of the adjoining rail car (on the other side, i.e., **232**) and the end of deck **47** of rail car unit **34**. Since transition plates **230** and **232** are relatively thin (5/8 inch) they do not present a large bump when highway trailer wheels encounter them. Transition plates **230**, **232** each have a U-shaped central relief **237** formed in distal portion **239** to avoid fouling pin **204** (or **205**).

In the preferred embodiment, the upper surface of bridge plate **150** is roughly flush with the level of the adjacent end of deck **47**, as taken at the height of the upper surface of the top flange fabricated cross-beam **136**, such that a generally level roadway is formed. It is possible to conduct highway trailers from bridge plates **150** to deck **47** without the use of transition plates **230**, **232**, but is more advantageous to use transition plates. It is also not necessary that the depth of shelf portion **134** relative to the end of the deck, (i.e., the height of the step) indicated as $\mathbf{D_1}$, be the same as the depth of bridge plate **150**, indicated as $\mathbf{D_2}$. It is advantageous that the height differential between the top of bridge plate **150** and the end of deck **47** be small, such as less than 1 – ½ inches, and better still, less than ½ inch to reduce the potential bump. The severity of the bump is also reduced by the use of transition plates **230**, **232**, that permit a mismatch in height to be taken up over a modest longitudinal distance, rather than suddenly.

It is also possible to use a bridge plate support member other than shelf portion **134**. For example, a cross-beam or cantilevered beam could be used, whether mounted to end sill **122**, center sill **60**, side sills **84**, **86** or some combination thereof. Alternatively a pedestal could be employed having an upwardly protruding pin in place of pin **204**, and an alternative form of second retainer in place of pin **205**, such as one or more retractable abutments, whether spring loaded or otherwise in the manner of spring loaded detents, or a releasable hook or latch, could be used to similar effect. The use of a bridge plate kit including bridge plate **150** and pins **204** and **205** is advantageous since pins **204** and **205** are interchangeable, are used to

provide motion tolerant retention of the proximal end (by pin **204**) and distal end (by pin **205**) of bridge plate **150** in either lengthwise or cross-wise positions, are relatively robust, and are of relatively simple fabrication.

Left and right hand cam cranks are indicated in Figures **3h** and **7a** to **7g**, as **241, 242**. Each cam crank is formed from a bent steel bar. Each cam crank has an inboard hinge portion **244** and an outboard hinge portion **246** that lie on a common hinge axis, **248**. As shown in Figures **7f, 7g**, inboard hinge portion **244** seats in an aperture or socket **245** mounted to the underside of, and at the laterally outboard edge of, top flange **72**, longitudinally outboard of main bolster **120**. Outboard hinge portion **246** seats in an aperture **247** formed through side sill **84** (or **86**, as the case may be). Socket **245** and aperture **247** act as hinge fittings within which the shaft portions of cam cranks **241** and **242** are constrained to turn. The laterally outboard, or distal, end of hinge portion **246** has a torque input fitting, in the nature of an obliquely angled transverse bore indicated as slot **249**. This angle, α, is greater than the outward cant of the side sill web and, in the preferred embodiment illustrated is about 25 degrees. Slot **249** admits entry of a lever member in the nature of a turning handle, or pry bar, by which means railroad personnel can impose a turning torque on cam crank **241, 242**. As shown, oblique slots **249** are formed in both ends of cam crank **241, 242** permitting the same part to be used as either **241** or **242** rather than requiring fabrication of different left hand and right hand parts. The obliqueness of slot **249** permits a straight bar to be inserted with less tendency, when rotated, to foul side sill **84** or **86** as the case may be. Although slot **249** is preferred, other types of torque input fitting, such as a bent arm (to act as a lever), a lateral pin of shaft, a keyway, a spline or splines, a hexagonal or square head to be engaged by a wrench or socket, an allen head and so on could be used. Slot **249** conveniently does not require the use of a special socket or key of a particular size.

A first radially extending member, in the nature of an M-shaped cam throw portion **250** extends between inboard and outboard hinge portions **244** and **246**, and will be forced through an arcuate path when a sufficiently large torque is applied though the crank. In so moving, the flattened peaks of the M-shape, indicated as **254, 255**, act as cams that work to raise distal portion **239** of bridge plate transition plate **230**, (or **232**), forcing plate **230** (or **232**) to pivot, the proximal end of plate **230** being held down by hinge tangs **234, 236** so that the tip, i.e., distal portion **239** of plate **230** (Figures **6a, 6b, 6c**) is lifted clear of bridge plate **150**. Flattened peaks **254** and **255** (Figures **7a, 7b, 7c**) are provided with bushings, or rollers **257**, that bear against the underside of bridge plate transition plate **230** (or **232**).

If bridge plate **150** is in an employed, i.e., extended, position when transition plate **230** is lifted, it may tend to want to droop downward since it is cantilevered out over end sill **122** without sufficient reaction force, or weight, at the proximal end to keep the distal end up. A downward droop may tend not to be advantageous when pushing cars together to be coupled, since the distal tip would then have a tendency to jam into the end sill of the adjacent car. It is also not desirable to require railroad employees to have to hold the bridge plate tips up as railcars come together. To that end the middle portion of the M-shape, indicated as **258** has a retainer, in the nature of a protruding catch, pawl, tooth, stop or abutment **260**, fabricated in the form of a bent, t-shaped tang **261** with arms welded to either side of portion **258** and the tongue of tang **261** extending above and beyond portion **258**. When cam crank **241** is rotated to lift plate **230**, abutment **260** is placed in a position to intercept the most inboard edge **262** of sheet **152**. When thus engaged, abutment **260** discourages bridge plate **150** from drooping as adjacent cars are brought together.

Further, cam crank **242** can be moved to a fully engaged position to lift transition plate **232** whether or not a bridge plate is present. When the tip, or distal, portion **239** of plate **232** is thus lifted, the distal tip of a bridge plate **150** of an adjoining car can then be introduced, as shown in Figures **8a** and **8b**. As the tip of the other bridge plate moves into position, it engages the M-shape of cam crank **242** and pushes it backward (i.e., counterclockwise from the viewpoint of a person standing beside car unit **34** facing side sill **86** on the handle side of cam crank **242**) to a disengaged position. As this happens, transition plate **232** falls down to engage the upper surface of the incoming bridge plate in an overlapping position. Once the tip of the other bridge plate is on shelf portion **134** (Figure **8d**) it can be nudged (if required) into position to permit pin **205** to be inserted.

The sequence of operation for uncoupling two rail road cars such as cars **21** and **22** to permit conversion from "drive-over" ends to a "ramp end" is as follows: Remove the cross-pin from the lower slot of pin **205**. Lift pin **205** and place on deck **100**. Support the distal tip of bridge plate **150** (can be manually lifted, or alternatively, propped in place). Engage a pry bar or similar bar as a lever in the outboard oblique slot in cam crank **241**, and apply a force to the bar to generate a torque to twist cam crank **241** counter-clockwise (as viewed facing the side sill by a person standing beside the car applying force to the lever). This causes the distal edge of transition plate **230** to lift, thereby disengaging plate **230** from bridge plate **150**. Engage abutment **260** to edge **262** of bridge plate **150**. (The distal tip of bridge plate

150 can be released once abutment **260** is engaged). Engage a pry bar as a lever in the outboard oblique slot in cam crank **242** and twist in a clockwise direction to lift transition plate **232** to a position for receiving another plate. (This step can either precede or follow the step of lifting transition plate **230**). Operate the uncoupling rod to unlock the coupler and close the angle cocks (standard steps for uncoupling railcars generally). Pull the rail road cars apart. Rotate (i.e., pivot) bridge plate **150** clockwise (as viewed from above) on pin **204** until toes **88** and **90** rest on shelf portion **134** beneath the overhang of plate **232**. Adjust as needed to permit pin **205** to enter collar **200**, and install pin **205** to secure the distal end of the bridge plate in place in the stored position. Lower plate **232** to engage, i.e., sit on, bridge plate **150**.

To reverse the process: Unlock, and remove pin **205**. Use a pry bar as a lever in the outboard oblique bores (i.e., slot **249**) of cam cranks **241**, **242** to raise intermediate transition bridge plates **230**, **232**, disengaging them from bridge plate **150**. Haul bridge plate **150** out of its storage position by rotating (i.e., pivoting) it counter-clockwise about pin **204** to the extended position, with edge **262** restrained under abutment **260**. This is the position shown in Figure **8a**. Advance the rail cars towards each other to cause the respective bridge plates **150** to be received under respective intermediate transition plates **232**, each bridge plate advancing to encounter cam crank **242** of the opposing railcar, knocking it down as the couplers connect. (See Figures **8b**, and **8c**). Replace pins **205** of each respective car, nudging or adjusting the bridge plates as required, partially raising bridge plate **232** if necessary to facilitate this nudging, and locking pins **205** in place when seated satisfactorily, thus securing bridge plate **150**. Lower plate **230** onto bridge plate **150**. Re-establish the coupling between the two cars, including brake lines. The train is again ready to be moved along the rail line.

Alternatively, following the sequence of Figures **8a**, **8e**, **8f** and **8d**, when moving the rail road cars together, once the toe of bridge plate **150** (of, for example, car unit **34** of car **22**) overhangs shelf portion **134** of the adjacent car (e.g., car unit **36** of car **24**), locomotive **38** can be stopped. Bridge plate **150** can be lowered to lie on the receiving portion of the adjacent car, namely shelf **134**, by twisting cam crank **242** to release the heel edge, edge **262**, of bridge plate **150**. The locomotive can continue to urge the cars together, with bridge plate **150** sliding across shelf **134** to meet cam crank **241**. The procedure may then continue as before, with re-insertion of pin **205**, and so on.

In either sequence, the process includes the steps of positioning the respective bridge plates of the rail road cars in a length-wise orientation and advancing the rail road cars toward each other to cause their respective couplers to mate. The step of advancing includes the step of engaging an extended portion, the distal tip, of each of the bridge plates with a receiving member, shelf portion **134**, of the other rail car. The step of positioning each of the bridge plates includes securing the distal tip in a raised attitude relative to the proximal portion, as described above. The step of engaging includes a step of securing each the bridge plate to the other of the rail road cars by re-inserting hinge pin **205** to link slot **186** of each bridge plate with the socket formed by the respective collars, **200**.

The step of advancing the cars together is preceded by the step of moving (i.e., raising) transition plates **232** to the raised position to facilitate engagement of bridge plate **150** with the receiving member, namely shelf portion **134**. The step of engaging is followed by the step of placing, (i.e., lowering) transition plate **232** to an overlapping position between the received distal tip of bridge plate **150** and vehicle carrying deck **47**. The step of raising transition plate **232** includes the step of employing a prop, namely cam crank **241** to maintain transition plate **232** in the raised position. The step of engaging includes advancing the bridge plate to disengage the prop, thus causing transition plate **232** to move to the overlapping position.

On level track, the swinging of bridge plate **150** between length-wise and cross-wise positions occurs in the plane of shelf portion **134**, that plane being a horizontal plane, such that rail yard personnel do not need to raise (or lower) the bridge plate to (or from) a vertical, or nearly vertical, position as was formerly common. Further still, since the arrangement of bridge plate **150** can accommodate train motion, whether due to pitch, yaw, roll or uneven spring compression between, for example, car units **34** and **36**, bridge plate **150** may remain in its extended, bridging position spanning the gap between units **34** and **36** when rail road cars **22** and **24** are in motion, and does not need to be moved each time the train is loaded or unloaded. Bridge plate **150** may tend not to need to be moved to or from its stowed position except when rail road cars **22** and **23** (or such others as may be joined together) are split apart from their neighbours, or joined together again. This may occur only relatively infrequently to permit the train consist to be changed. This may tend to reduce the number of times rail yard personnel are required to handle the bridge plates, and may tend to reduce the length of time required for loading and unloading.

The process for changing bridge plate **150** from the length-wise position to the cross-wise position is relatively simple: the rail car is established in an uncoupled position by uncoupling the rail road cars and moving them apart, thus disengaging the distal tip of bridge plate **150** from the adjacent car, and establishing bridge plate **150** in the extended position. Pin **205** is removed, transition plate **230** is disengaged from bridge plate **150** by raising its distal portions clear of bridge plate **150**. Plate **232** is also raised. Then bridge plate **150** is moved from the length-wise position to the cross-wise position. As noted, the step of moving includes swinging bridge plate **150** in the horizontal plane of portion **134** about the pivot mounting provided by the interaction of pin **204** in collar **200**. This is followed by securing bridge plate **150** in place by reinserting pin **205** as a retainer, and by re-engaging transition plates **230**, **232**, as by lowering them to the overlapping position. The step of disengaging the transition plate from the bridge plate includes the step of operating cam cranks **241**, **242** to lift the distal portions of transition plates **230**, **232**. The step of operating the cam cranks includes the step of turning them to bear against the transition plates.

The process of converting and re-coupling cars can be followed by a series of steps for unloading, and then loading (or re-loading) that include placing ramps at the rail road car ends, as described above and shown in Figures **1a** - **1e**. In the loading and unloading processes the hostler truck and the highway trailers will cross bridge plate **150** in its stored, or laterally transverse, position.

It may be noted that while telescoping bridge plates could possibly be employed, it is preferred to use a monolithic bridge plate, such as bridge plate **150**. That is, bridge plate **150** is a rigid beam. It does not have two beam portions that slide together. The pivot fitting at the proximal end anchored by pin **204**, and the combined pivot and slot fitting for engaging pin **205** have a relatively large tolerance, and do not bear either a shear load or a bending moment load when vehicles traverse bridge plate **150**. Bridge plate **150** acts as a lintel, or beam, of sufficient length to span the gap between the ends of the two adjacent rail road cars when motionless on straight track, the lintel being supported at either end by two shelves. As such, it has the advantage of comparative simplicity.

The foregoing description has been generally directed to elements related to deck **47** and operational features associated with deck **47**. Figures **11a** and **11b** show the draft gear at the coupler end of rail car unit **34**, being representative of the coupler end draft gear of rail road cars **21**, **22**, **23**, **24** and **25** more generally. Coupler pocket **62** houses a coupler indicated as **44**. It is mounted to a coupler yoke **378**, joined

together by a pin **380**. Yoke **378** houses a coupler follower **382**, a draft gear **384** held in place by a shim (or shims, as required) **386**, a wedge **388** and a filler block **390**. Fore and aft draft gear stops **392**, **394** are welded inside coupler pocket **62** to retain draft gear **384**, and to transfer the longitudinal buff and draft loads through draft gear **384** and on to coupler **44**. In the preferred embodiment, coupler **44** is an AAR Type F70DE coupler, used in conjunction with an AAR Y45AE coupler yoke and an AAR Y47 pin. In the preferred embodiment, draft gear **384** is Mini-BuffGear such as is available, for example, from Miner Enterprises Inc., supra, or from the Keystone Railway Equipment Company, of 3420 Simpson Ferry Road, Camp Hill, Pa. As taken together, this draft gear and coupler assembly yields a reduced slack, or low slack, short travel, coupling as compared to a Type E coupler with standard draft gear or an hydraulic EOCC device. As such it may tend to reduce overall train slack, and may tend to reduce the range of travel to be accommodated by bridge plates **150**. In addition to mounting the Mini-BuffGear directly to the draft pocket, that is, coupler pocket **62**, and hence to the structure of the rail car body of car unit **34**, the construction described and illustrated is free of other long travel draft gear, sliding sills and EOCC devices, and the fittings associated with them.

Mini-BuffGear has between 5/8 and 3/4 of an inch travel in buff at a compressive force of 700,000 Lbs. Other types of buff gear can be used that will give an official rating travel of less than 2 1/2 inches, or if not rated, then a travel of less than 2 1/2 inches under 500,000 Lbs. buff load. It is advantageous for the travel to be less than 1.5 inches at 700,000 Lbs., buff load and, as in the embodiment of Figures **11a** and **11b**, preferred that the travel be at least as small as 1" inches or less at 700,000 Lbs. buff load.

Similarly, while the AAR Type F70DE coupler is preferred, other types of coupler having less than the 25/32" (that is, less than about 3/4") nominal slack of an AAR Type E coupler generally or the 20/32" slack of an AAR E50ARE coupler. In particular, in alternative embodiments with appropriate housing changes where required, AAR Type F79DE and Type F73BE, with or without top or bottom shelves; AAR Type CS; or AAR Type H couplers can be used to obtain reduced slack relative to AAR Type E couplers.

Other than brake and minor fittings, the basic structure of center sill, cross-bearer and decking structure of intermediate car unit **30** is substantially the same as car units **26** and **34**. Car unit **26**, shown in Figures **9a** (isometric), **9b** (top), **9c** (side view) and **9d** (underframe) differs from car unit **34** primarily in having a female set of

side bearing arms, like those of car unit **30** adjacent to car unit **34**. The hitch arrangement will be different, with the hitches on all of car units **26**, **30** and **34** being arranged such that trailers mounted thereon will have their forward ends (i.e, the end with the king pin) facing toward end portion **64** of car unit **34**. Car units **26**, **30** and **34** may also vary in their brake arrangements, and other fittings, but share the same basic structural features. However, as intermediate unit **30**, shown in Figures **10a** (isometric), **10b** (top), **10c** (side view) and **10d** (underframe) has no coupler end, its construction can be conceptualized as having the articulation connection end of car unit **34** taken from a mid span section, with a set of male side bearing arms, and the articulation connection end of car unit **26** with female side bearing arms, also taken from mid-span section, and joining them together in one car, with the pair of female side bearing arms facing car unit **34** and the pair of male side bearing arms facing car unit **30**.

Various embodiments of the invention have now been described in detail. Since changes in and or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to those details.